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by the receding tide, which made it impossible for ships to approach within easy distance of the city. In the sky flocks of frigate birds and pelicans were sailing, the former with the grace of eagles, the latter like clumsy clown dogs in a circus, imitating the motions of skilled actors, but imitating them very successfully. It was with great regret that we left the interesting old city and returned to Aspinwall.

On the 9th of March we got under way and headed for Key West.

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WASHINGTON, D. C.

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### **Notes on the ferns of the Isle of Pines, West Indies**

OTTO E. JENNINGS

In connection with a natural history expedition from the Carnegie Museum, it became the good fortune of the present writer to devote most of the month of May, 1910, to botanizing in the Isle of Pines, West Indies. A report embodying the botanical results of the expedition will eventually be presented for publication in the Annals of the Carnegie Museum, but it has been suggested that a brief account of the expedition relative to the ferns seen and collected might be desirable for the AMERICAN FERN JOURNAL. With this in view, this article was written.

The Isle of Pines lies about sixty miles south of the west central portion of Cuba, somewhat west of the meridian of Havana, and contains about 1,200 square miles of territory. The island consists, roughly speaking, of two islands, a north one and a south one, separated by a great swamp running east and west. The northern portion is somewhat elliptical in shape and measures about twenty miles across from north to south and thirty

miles from east to west, while the southern portion is about forty miles long from east to west and perhaps ten miles wide at its greatest north and south extent. The intervening marsh consists of the mangrove formation running in from indenting bays at the east and west, and in the middle can be waded in the dry season. Evidently the marsh is being filled in by the aid of vegetation, and eventually the two portions of the island will become united by dry land.

Topographically the island is a low-lying level plain from which rise sharply here and there broken ridges, which have a general trend from northwest to southeast. The ridges are composed of steeply inclined strata of more resistant rocks, the strata dipping to the east-northeast, so that the slopes are not generally so precipitous on that side as on the south and west. In the northern part of the island the Sierra de los Caballos reaches a height of about a thousand feet, and, like its companion ridge about three miles to the west, the Sierra de las Casas, it has quite precipitous slopes and is composed mainly of a crystalline marble. The Sierra de Cañada in the west central part of the island has somewhat more gentle slopes and, notwithstanding reports to the contrary, consists of an impure mica schist. This ridge was found by the aneroid to lack but a few feet of the height of Caballos, in the northern part of the island.

Inland the island has a gently undulating plain of probably purely subaerial erosion and reaching a height of about two hundred feet above the sea in the central part of the island. The drainage areas run in all directions radially from the central portion of the island, and have broad basins with gentle slopes. Around the northern mountains is a fine series of wave-cut cliffs at about fifty to sixty feet above the present sealevel; and from this point seaward the gently sloping plain gradually blends into the recent coastal deposits, which are occupied

practically all around the northern portion of the island by a broad belt of the mangrove formation. There appears to have been in recent times an elevation of the island sufficient to have enabled the streams to cut down steep channels, at least in the lower part of their courses, so that subsequent depression to the present level has resulted in submerging the lower courses of the rivers, thus making them subject to tide water for often eight or nine miles from the mouth. The forests of the mangrove formation have at the same time advanced upon the lower parts of the depressed plain.

The soil of the greater part of the in and plain consists of a yellowish red or brownish red gravelly clay, known as the Mal Pais Gravel. This soil is evidently residual, being derived by subaerial erosion from underlying marbles and schists. In depressions, and especially on the low plain below the contour of the ancient elevated sea cliffs, the Mal Pais Gravel is replaced by a light yellow or somewhat gray sandy loam. In the west central part around Los Indios there are considerable areas of almost pure glistening white quartz gravel and coarse sand mixed here and there with more or less iron. Towards the coastal fringe the soil becomes alluvial, being composed of varying mixtures of beach deposits and remains of vegetation.

The southern component of the island, that south of the marsh, consists, so far as is known to the present writer, of a rather uniformly level coral-limestone plain but little elevated above the sea. At Caleta Grande, along the median western portion of the south coast, where reached by the present writer, the rock is being cut away by the perpetually pounding surf, aided by occasionally terrific storms, and the jagged perpendicular cliffs are perhaps eighty feet at their greatest height. The soil on this coral-limestone plain consists of a very scanty dark loam which in places merely fills the irregular

cracks and hollows in the underlying rock.

The climate of the island is, of course, oceanic and quite equable. The latitude being but about twenty-one degrees north, the extreme range of the thermometer lies between about 50° and 100° F. The temperatures experienced by the writer during his sojourn on the island in May, with the sun exactly overhead at noon, were from 82° to 92° F. during the day, while at night, temperatures as low as 70° F. were rarely experienced. The temperature of the ocean water on the beaches was 80°-82° F., while a mineral spring at Santa Fé was said to register 88° F. The well and spring waters, so far as tested, ranged generally from about 68° to 80° F. as they came from the ground. The island has a dry season, with showers very rarely, from November to May, while during the latter month, or about the first of June, there begins a wet season, with torrential rains, which fill to the brim the sharply cut channels of the rivers, and flood portions of the low-lying plains.

The first ten days of our stay in the Isle of Pines was spent in the exploration of the northeastern portion of the island, with Nueva Gerona as the base of operations. Nueva Gerona lies between the ridges Caballos and Casas, on the Casas river, about two miles from the sea. The soil is mainly Mal Pais Gravel clay on the gentle undulations and knolls, with more or less of the light-colored sandy loam in depressions and on the lower levels, this latter type passing into the alluvial soil of the coastal fringe, which along the river comes up nearly to the town.

In the whole island no ferns were found on the Mal Pais Gravel type of soil. One fern, *Pteridium caudatum* (L.) Maxon, occurs on the light-colored sandy loam about a mile east of Nueva Gerona, where it forms low bracken thickets, of small extent but very similar to those formed by its more cosmopolitan congener in our own northern

States. The best fern collecting in the Nueva Gerona district, as indeed for the island in general, was along the steep clayey or rocky banks of the arroyos. These had at that time but little water, only here and there pools, but the narrow and steep-banked channels were usually shaded by thickets of the coco plum and other shrubs or trees and were moist enough to favor the growth of many ferns. Growing out of the side of the perpendicular banks of a shallow arroyo, about a mile east of Nueva Gerona, were discovered two communities of the tree fern, *Cyathea arborea* (L.) Sm., with ascending trunks six or seven feet tall. In other similar arroyos, often where shaded by the coco plum, were *Adiantum cristatum* L., *A. fragile* Sw., and *Blechnum serrulatum* Rich.

At the outskirts of a jungle around a fresh-water pond near the base of Caballos ridge, there was found climbing in masses upon other vegetation, waist high, *Lycopodium cernuum* L., and near by, growing in much the same manner, the apparently delicate but in reality tough and wiry and decidedly thorny *Odontosoria fumarioides* (Sw.) J. Sm. About a mile north of Nueva Gerona, on the outskirts of the forest of the mangrove formation and where the soil consists mainly of humus, being probably at times brackish, were great tussocks of *Acrostichum aureum* L., with spreading fronds often as high as a man's head—magnificent specimens, the like of which we never see in the conservatories of the North. In the tussocks with this fern, but apparently not forming tussocks of its own, were fine specimens of *Nephrolepis biserrata* (Sw.) Schott. In a clearing at the edge of this same swamp forest was found *Tectaria martinicensis* (Spr.) Maxon. In a swamp forest with the royal palm, maumee apple, coco plum, etc., along a stream a few miles east of Nueva Gerona, there was found *Meniscium reticulatum* (L.) Sw., forming large hummocks similar to those of *Acrostichum aureum* L., and with the heavily fruiting leaves spreading

in all directions. In a forest on swampy soil, near the base of Mount Columbo, was found *Dryopteris patens* (Sw.) Ktze., while on the ground and at the base of trees near the coast east of Vivijagua, *Campyloneurum phyllitidis* (L.) Presl was collected in the mangrove formation.

Upon climbing the Sierra de los Caballos there was found on trees at the top of the ridge, at an elevation of about one thousand feet, the widely distributed *Polypodium polypodioides* (L.) Hitchc. This fern is claimed to have been at one time quite abundant on the northern mountains of the island, but it has been assiduously collected by the so-called "natives" for medicinal purposes and has apparently been all but exterminated there. In rather moist humus soil in the forest at the base of the mountain, among the rocks of the ancient sea cliff, *Adiantum villosum* L. was found, with the rachis quite conspicuously brown-villous.

In the western part of the island, in the vicinity of Los Indios, a mangrove forest fringes the river, and back of the town grades into a fresh-water jungle in which occur most of the species found in similar habitats in the northern part of the island near Nueva Gerona. *Meniscium reticulatum* was here quite common. The upper course of the Rio de los Indios, as well as also many of the tributary arroyos, have sharply cut banks along which the mica schist rocks are often exposed under the mantle of gravel clay. Along these banks occurred *Blechnum occidentale* L.; a climbing *Lygodium*, near *L. cubense* H. B. K.; *Dryopteris deltoidea* (Sw.) Ktze.; and a small *Trichomanes*, near *T. pyxidiferum* L. *Dicranopteris flexuosa* (Schr.) Und. [*Gleichenia flexuosa* (Schr.) Mett.] was found along a small arroyo near the base of the Sierra de la Cañada.

Along the lower course of the Majagua, north of Los Indios, there are considerable deposits of sand along the banks and in the bed of the stream, and along the banks

were found *Lygodium cubense* H. B. K., clambering over low shrubbery or twisting itself into dense mats; a *Lindsaya*, rather near *L. portoricensis* Desv., but small; and more of the same *Trichomanes* found in the upper Los Indios drainage.

One day was spent on the coral-limestone peninsula which forms the southwestern extension of the island. Practically the whole trip was along a trail through a tropical jungle where perhaps half of the vegetation consists of species not seen in the northern portion of the island, but no ferns were seen there.

The last two days of field work were spent in the east central portion of the island, where the soil and vegetation are quite similar to those of the Nueva Gerona district. On the palm trunks along the banks of the upper Rio de Santa Fé, south of the town of Santa Fé, *Phlebodium aureum* (L.) J. Sm. was quite common. Near the magnesia springs at Santa Fé the steep banks of the short ravines leading to the river have been cleared of most of the shrubbery, but the larger trees have been left standing, and along the springy shaded banks of these ravines ferns were abundant. Within the space of probably not over two hundred feet square were collected *Dryopteris sancta* (L.) Ktze., *Tectaria trifoliata* (L.) Cav. [*Aspidium trifoliatum* (L.) Sw.], *Adiantum cristatum* L., *Dryopteris patens* (Sw.) Ktze., and *Ceropteris tartarea* (Cav.) Link.

So far as known to the present writer, only three other collections that have included ferns have been made on the Isle of Pines. Seven species were collected by Dr. J. F. Shafer, the orchid enthusiast of Pittsburg, during March 1910, mainly around springs to the west of Santa Fé; thirteen species by Mr. A. H. Curtiss, in the Nueva Gerona district during the winter of 1903-04, and distributed in his sets of West Indian plants; and one species by Dr. C. F. Millspaugh, February 1899, from Pedernales Point, at the southeastern extremity of the island.



To make our lists more complete, there follows an enumeration of the species collected by these botanists.

By Dr. J. F. Shafer:

- Adiantum melanoleucum* Willd.
- Blechnum occidentale* L.
- Cyathea arborea* (L.) Sm.
- Dryopteris deltoidea* (Sw.) Ktze.
- Goniopteris obliterated* (Sw.) Und.
- Odontosoria fumarioides* (Sw.) J. Sm.
- Lycopodium cernuum* L.

By Mr. A. H. Curtiss:

- Adiantum fragile* Sw.
- Adiantum melanoleucum* Willd.
- Adiantum villosum* L.
- Alsophila Wrightii* Und.
- Blechnum occidentale* L.
- Dicranopteris flexuosa* (Schrad.) Und.
- Goniopteris obliterated* (Sw.) Und.
- Lygodium polymorphum* (Cav.) H. B. K.
- Nephrolepis biserrata* (Sw.) Schott
- Neuromanes pinnatus* (Hedw.) Und.
- Odontosoria fumarioides* (Sw.) J. Sm.
- Lycopodium cernuum* L.
- Marsilea caribæa* Und.

By Dr. C. F. Millspaugh:

- Asplenium dentatum* L.

For the identification of most of his Isle of Pines collections the writer is indebted to the New York Botanical Garden. A complete series of specimens is deposited in the herbarium of the Carnegie Museum and a duplicate series is in the New York Botanical Garden. A set of the remaining duplicate ferns (and fern allies) will be placed in the herbarium of the American Fern Society.

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